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Research Article

An unexpected new tree species from Gansu, China: *Illicium gansuense* (Schisandraceae)

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Abstract

We describe the newly-discovered species *Illicium gansuense* (Schisandraceae), discovered in the Yuhe area of Giant Panda National Park, Gansu, China. Morphologically, *I. gansuense* resembles *I. ternstroemioides* and *I. arborescens*. However, the new species can be distinguished by its smaller leaf size, the larger number of tepals, tepal margin ciliate, and distinct flowering and fruiting seasons.

Key words: Austrobaileyales, basal angiosperms, Gansu, Giant Panda National Park, Illiciaceae, Yuhe area

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Introduction

The genus *Illicium* L., which belongs to the family Schisandraceae (APG IV 2016), consists of 35 species distributed across the southeastern United States, Mexico, the West Indies (five species), and eastern Asia (approximately 30 species) (Keng 1993). Linnaeus (1759) published the 10th edition of Systema Naturae, which included the first named species of *Illicium* (*I. anisatum* L.) based on Kaempfer's monograph. In 1947, Smith published the first comprehensive study of the genus *Illicium*, "The Families Illiciaceae and Schisandraceae", which divided the genus into two subgenera based on perianth morphology: 1) *I.* subgen. *Illicium* with thin, membranaceous and narrowly oblong or ligulate inner perianth segments; and 2) *I.* subgen. *Cymbostemon* with carnose to papyraceous and usually ovate to suborbicular inner perianth segments (Spach 1839; Smith 1947; Lin 1997). Both Hao's and Morris' results suggested that the previous division based on perianth morphology wasn't monophyletic (Hao et al. 2000). Morris et al. (2007) utilized a distinguishable seed character to reflect their evolution history: *I.* sect. *Cymostemon* contains seven species with a hilar rim around seed hilum; and *I.* sect. *Illicium* consists of all the other species which do not have a hilar rim.

China, especially the southwest and southeast parts of the country, is home to many species of *Illicium* species. In particular, the species *I. henryi* Diels. is known to occur only in southern Gansu Province.

Illicium has considerable economic value, with *I. verum* Hook.f. being particularly valuable domestically in China and exported worldwide. The fruits of *I. verum* are used as a spice, and the leaves and fruits are steam distilled to create an aromatic oil (star anise oil) for use as a flavoring, as well as a therapeutic agent in traditional Chinese medicine (TCM). Other species of *Illicium* are used ornamentally or as a source of fine wood for furniture.

While surveying plants in the Yuhe area of the Giant Panda National Park, Gansu, in October 2020, we discovered an unknown species of *Illicium*. Based on field surveys, morphological and phenological studies, and taxonomic literature reviews, we concluded that this species should be included in *I.* sect. *Cymbostemon* (Spach) A.C.Smith (Smith 1947). However, because the specimen differed from other members in the section, we named and established the specimen as a new species (*I. gansuense*), as described herein.

Material and method

All morphological data were obtained from field observations carried out in the Yuhe Area of the Giant Panda National Park, Longnan City, Gansu Province, eastern China. Plants were photographed with a Nikon D750 digital camera. Digital specimens were deposited at the IBSC, KUN, PE, IBK, and WUK herbaria through the Chinese Virtual Herbarium (https://www.cvh.ac.cn/). Physical specimens were deposited at the NWTC Herbarium. All terminology used in the present study is in accordance with the Flora of China (Lu and Rabeler 2001), as well as the Plant Photo Bank of China (PPBC) and the Chinese Field Herbarium (CFH). The conservation status of the new species was assessed according to the standards of the IUCN (2012).

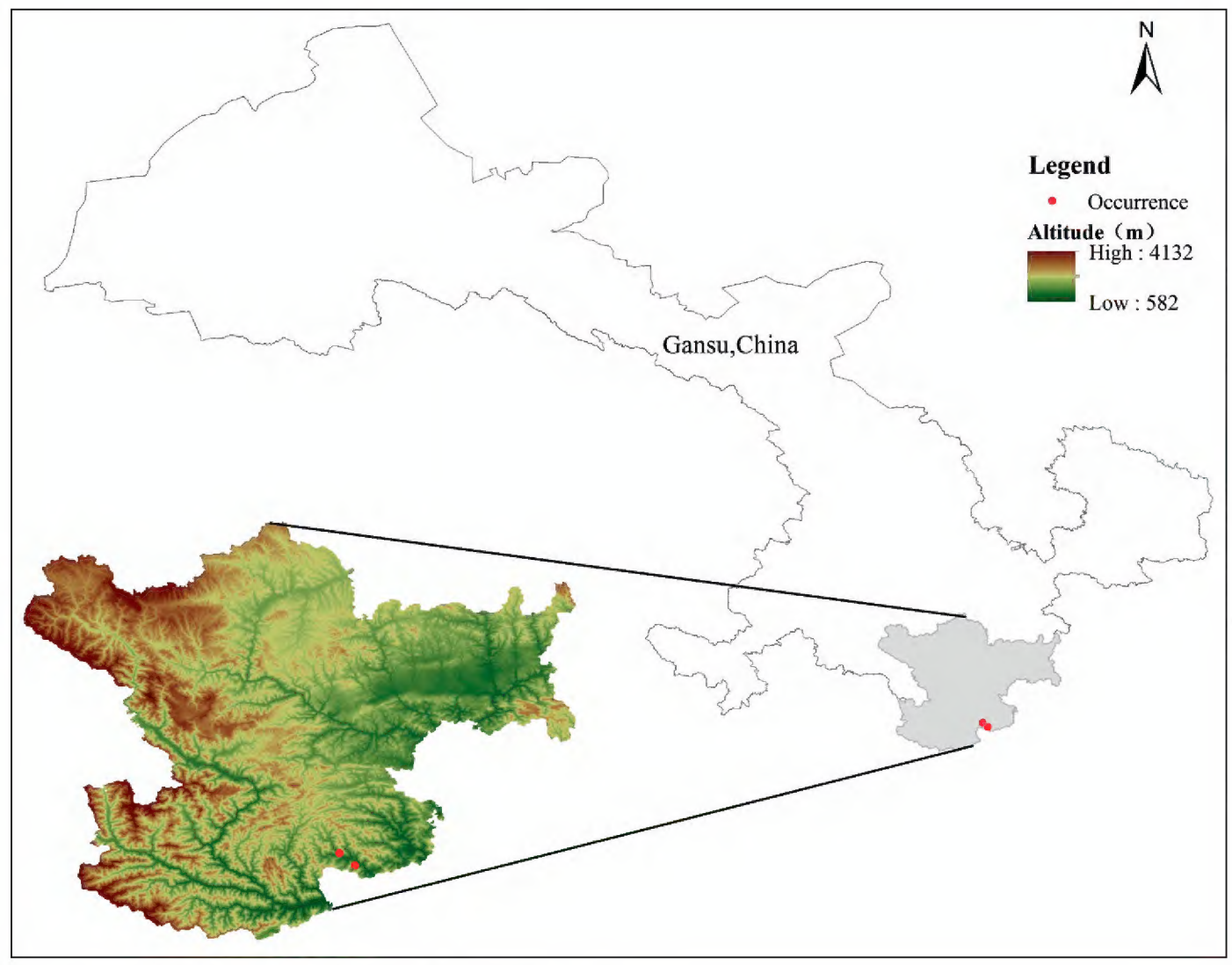

Figure 1. Distribution of *Illicium gansuense*.

Taxonomic treatment

***Illicium gansuense* Z.F.Bai & Xue L.Chen, sp. nov.**
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Figs 2–4

Type. China. Gansu: Longnan City, Yuhe Area of Giant Panda National Park, altitude ca. 1200 m, 4 April 2020, *Zengfu Bai & Xuelin Chen 2020001* (***holotype*:** NWTC!; ***isotype*:** NNBG!).

Diagnosis. *Illicium gansuense* is similar to *I. ternstroemioides* and *I. arborescens* in overall form, leaf characters, red flowers, location, and population density. *Illicium gansuense* can be distinguished from *I. ternstroemioides* and *I. arborescens* based on leaf-blades size (7–12 × 1.8–3.5 cm in *I. gansuense* vs. 7–13 × 2–5 cm in *I. ternstroemioides* vs. 6–12 × 2–4.5 cm in *I. arborescens*), tepal number and pubescence (10–17 tepals with ciliate margins vs. 10–14 tepals with glabrous margins vs. 14–21 tepals with glabrous margins), number of carpels (10–13 vs. 12–14 vs. 12–16), number and size of the stamens (23–27, 2–3 mm long vs. 22–30, 1.8–3.4 mm long vs. 39–41, 2–3 mm long), and ovary length (1–1.5 mm long vs. 1.3–2.5 mm long vs. 1–1.8 mm long). (Table 1).

Description. Trees 4–12 m tall, whole plant with an aniseed aroma. Trunk 22.5 cm diam. at chest height, outer bark grayish-brown, with irregular longitudinal cracks; canopy tower or conical and branches are dense and spread horizontally; twigs pubescent, perules ca. 3 × 2 mm, ovoid, yellowish-brown, caducous, margins finely ciliate. Leaves clearly spirally-alternate to pseudoverticillate (clustered in sets of 2–5 at the apex of twigs); petioles 8–12 mm long, 1–2 mm diam.; blades 7–12 × 1.8–3.5 cm, oblanceolate, coriaceous, translucent oil spots visible against the light, adaxially dark to medium green, glossy, abaxially light green, base cuneate, margin glabrous, apex acuminate; midvein adaxially slightly impressed, abaxially prominently round, lateral veins pairs 6–9, inconspicuous. Inflorescences 1-flowered, but flowers sometimes clustered in groups of 2–6 at the apex of branches, axillary, pedunculate; peduncle 8–14 mm long, 2 mm diam., brown, bracteoles 2–4 × 2–3 mm, ovate. Flowers 12–18 mm diam., bisexual, androgynous scented, anthesis diurnal; floral buds 5–10 × 3–6 mm, ovoid, brown; pedicels 5–12 mm long, 2 mm diam., brown; tepals 10–17, in 2–3 whorls, outer whorl with 5–7 tepals, 6–8 × 5–7 mm, ovate, sepaloid, yellowish-green, base round, margin red, ciliate, apex acuminate or

Table 1. Morphological, geographic, and phenological comparison of *Illicium gansuense*, *I. ternstroemioides*, and *I. arborescens*.

Trait	*I. gansuense*	*I. ternstroemioides*	*I. arborescens*
Leaf blades	7–12 × 1.8–3.5 cm	7–13 × 2–5 cm	6–12 × 2–4.5 cm
Tepals	10–17, margin ciliate	10–14, margin glabrous	14–21, margin glabrous
Carpels	10–13	12–14	12–16
Stamens	23–27, 2–3 mm long	22–30, 1.8–3.4 mm long	39–41, 2–3 mm long
Ovaries	1–1.5 mm long	1.3–2.5 mm long	1–1.8 mm long
Distribution	Gansu (eastern China)	Fujian, Hainan (southeastern China)	Taiwan
Flowering time	March–April	January–August	January–April

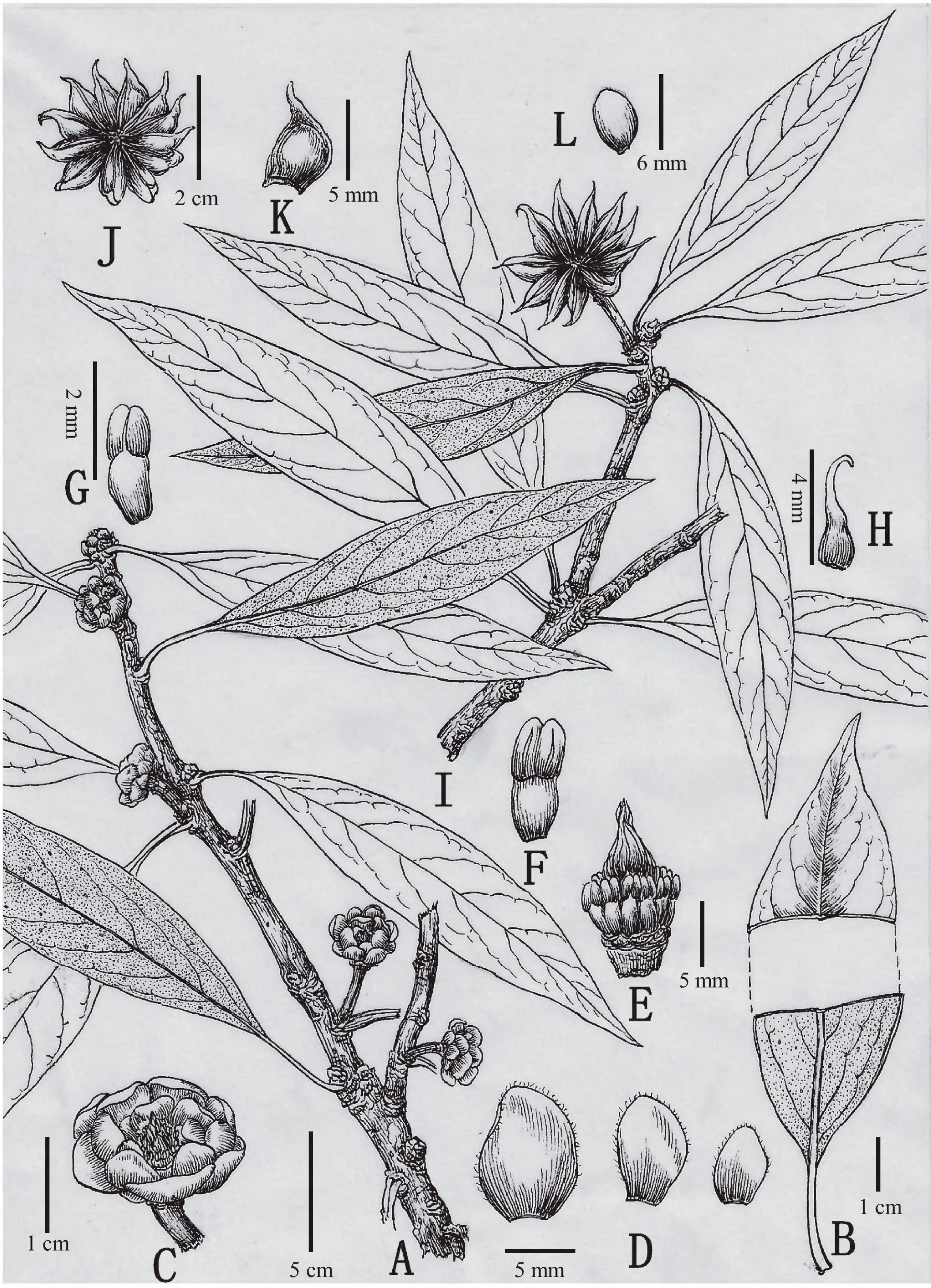

Figure 2. *Illicium gansuense* Z.F.Bai & Xue L.Chen **A** flowering branch **B** adaxial and abaxial leaf surface **C** flower **D** tepals **E** removal of tepals showing gynoecium and stamens **F, G** stamens, dorsal and ventral views **H** carpel **I** fruiting branch **J, K** fruits **L** seed. (Drawn by Jianlu Bai based on type specimen).

Figure 3. *Illicium gansuense* Z.F.Bai & Xue L.Chen **A** habitat **B, C** flowering branch **D** bark.

obtuse, inner whorls with 8–10 tepals, 8–12 × 4–8 mm, widely ovate to widely obovate to widely elliptic, petaloid, fleshy, red, base broadly cuneate, margin ciliate, apex acuminate; stamens 23–27, in 2–3 whorls, 1.3–3.5 mm long, filament 0.3–1.5 mm long, stout, widely obovoid to widely ellipsoid, pink, connective truncate to emarginate, pink, anther 1–2 × 0.6–1 mm, introrsely rimose, pollen grains trisyncolpate, blackish-brown *in vivo*; carpels 10–14, 3–5.5 × 1.6–2 mm, ovaries 1–1.5 mm long, stigmatic crest 1.3–1.8 mm long, slightly longer than the ovary, subulate. Follicetum 12–16 × 4–7 mm; peduncle 1–1.5 cm long; follicles 10–13, 15–25 × 5–8 mm, 2–4 mm thick, woody, dark brown, apex aristate due to the persistent and hardened stigmatic crest, 3–6 mm long, slightly curved at apex. Seeds 4.5–6 × 4–5 mm, 1.5–2.5 mm thick, ovoid, testa smooth, brown.

Distribution and habitat. Currently, only one population of *I. gansuense* has been identified in Yuhe Town, Longnan City, southern Gansu Province. This area is characterized by a northern subtropical subhumid climate and a mountainous terrain containing high peaks and steep slopes. Specimens of *I. gansuense* were found growing in a deciduous broadleaf forest at an elevation of 1200 m. The dominant species of this forest community include *Trachycarpus fortunei* (Hook.) H.Wendl. (Arecaceae), *Cinnamomum septentrionale* Hand.-Mazz. (Lauraceae), *Lindera aggregata* (Sims) Kosterm. (Lauraceae), and *Deyeuxia effusiflora* Rendle (Poaceae). (Fig. 1)

Phenology. Flowering from March to April, fruiting from May to November.

Conservation status. There is only one known location, and fewer than three individuals of *I. gansuense* were found during our fieldwork in the Yuhe area of Giant Panda National Park in 2020 and 2022. However, investigations of the natural distribution of this species are insufficient. According to the IUCN Red List criteria (2019), this new species is better assessed as Data Deficient (DD; criteria B1ab(i–v) + 2ab(i–v)).

Etymology. The specific epithet '*gansuense*' refers to a province in eastern China. 甘肃八角 (gān sù bā jiǎo) is suggested as a suitable Chinese name for it.

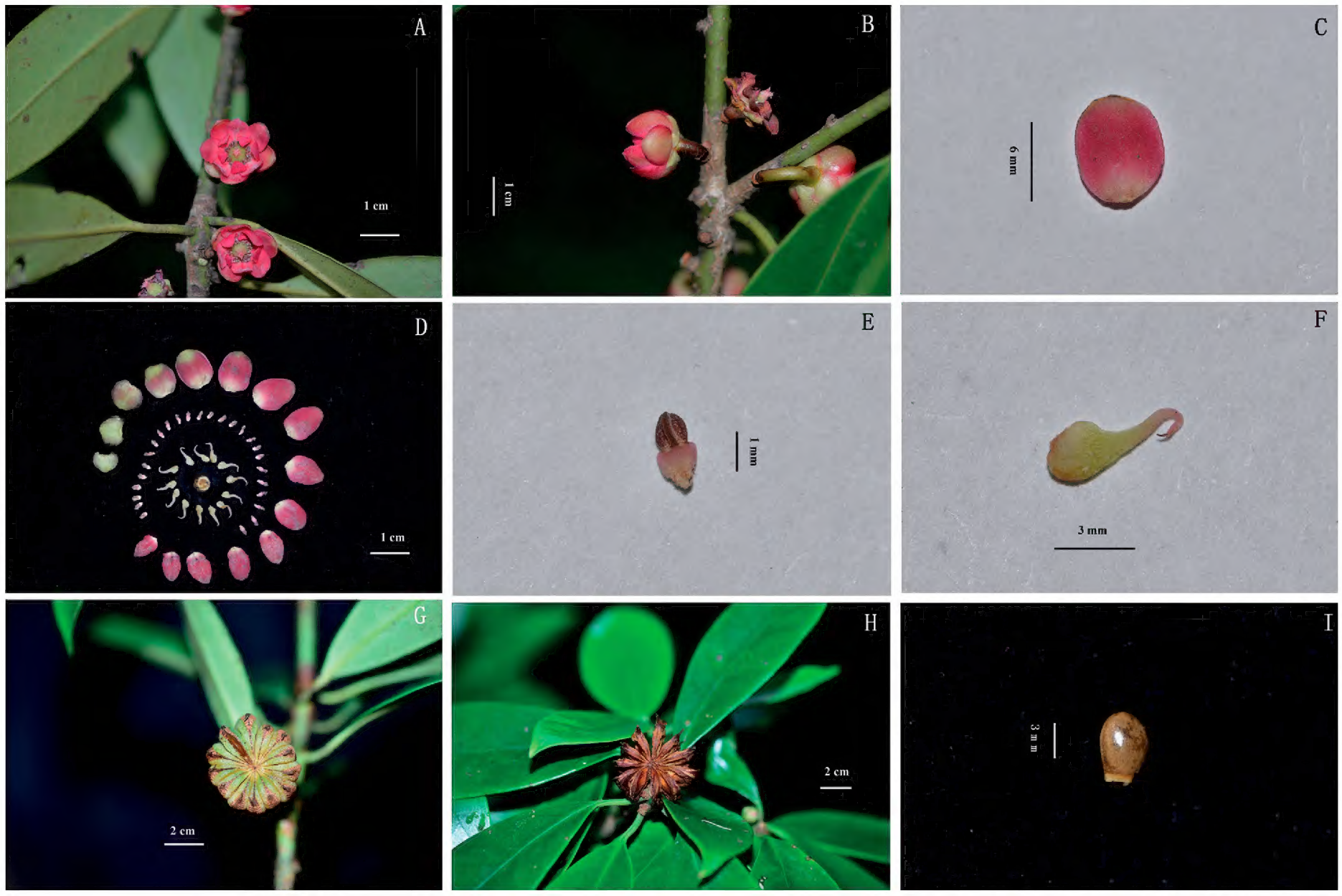

Figure 4. *Illicium gansuense* Z.F.Bai & Xue L. Chen **A** flower at front view **B** flower at side view **C** the largest tepals **D** all parts of flower **E** stamen **F** follicle **G** fruit at front view **H** fruit at side view **I** seed. Photographed by Zengfu Bai.

Notes. *Illicium gansuense* is similar to *I. ternstroemioides* and *I. arborescens* in overall form, that are all trees, leaf characteristics, flower color, location, and population density. However, as noted above, the three species can be distinguished according to both morphological features and distribution. Specifically, in relation to *I. ternstroemioides* and *I. arborescens*, *I. gansuense* is characterized by smaller leaf blades, tepals with ciliate margins (rather than glabrous), fewer carpels, and smaller ovaries. Additionally, *I. gansuense* blooms from March to April and *I. arborescens* blooms from January to April. (Table 1).

Acknowledgements

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

Methodology: ZZ. Writing – review and editing: ZB, XC, JZ.

Data availability

All of the data that support the findings of this study are available in the main text.

References

APG IV (2016) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnean Society 181(1): 1–20. https://doi.org/10.1111/boj.12385

Hao G, Saunders RMK, Chye M-L (2000) A phylogenetic analysis of the Illiciaceae based onsequences of internal transcribed spacers (ITS) of nuclear ribosomal DNA. Plant Systematics and Evolution 223(1–2): 81–90. https://doi.org/10.1007/BF00985328

IUCN (2012) IUCN Red List Categories and Criteria, Version 3.1. (2nd edn.). IUCN, Gland.

Keng H (1993) Illiciaceae. In: Kubitzki K, Rohwer JG, Bittrich V (Eds) The Families and Genera of Vascular Plants. II Flowering Plants–Dicotyledons. Magnoliid, Hamamelid and Caryophyllid Families. Springer, Berlin, 344–347. https://doi.org/10.1007/978-3-662-02899-5_42

Lin Q (1997) Systematics and evolution of the family Illiciaceae. PhD Thesis. Forestry College, South China Agricultural University, Guang Zhou, China. [In Chinese]

Linnaeus C von (1759) Systema Naturae. Editio Decima 2: 1042. [1050, 1370.]

Lu DQ, Rabeler RK (2001) Pseudostellaria. In: Wu ZY, PH Raven, Hong DY (Eds) Flora of China. Science Press, Missouri Botanical Garden Press, St. Louis, Beijing, 7–10.

Morris AB, Bell CD, Clayton JW, Judd WS, Soltis DE, Soltis PS (2007) Phylogeny and divergence time estimation in *Illicium* with implications for New World biogeography. Systematic Botany 32(2): 236–249. https://doi.org/10.1600/036364407781179734

Smith AC (1947) The families Illiciaceae and Schisandraceae. Sargentia 7: 1–224. https://doi.org/10.5962/p.265318

Spach E (1839) Histoire Naturelle des Végétaux: Phanérogames, Tome 7. Librairie encyclopédique de Roret, Paris, 444 pp.